

CLAIMS

What is claimed is:

1. A combustion turbine engine comprising:
 - a recuperator having a hot gas flow path and a cool gas flow path;
 - a compressor providing a flow of compressed gas to the cool gas flow path of the recuperator, the compressed gas being heated within the recuperator;
 - a source of fuel providing a flow of fuel;
 - a combustor receiving the heated flow of compressed gas from the recuperator and the flow of fuel from the source of fuel, and combusting a mixture of compressed gas and fuel to produce a flow of hot gas;
 - a radial flow turbine receiving the flow of hot gas from the combustor and discharging a flow of exhaust gas, the turbine including a rotating element that rotates in response to the flow of hot gas through the turbine;
 - an electric generator generating electricity in response to rotation of the rotating element of the turbine;
 - a diffuser receiving the flow of exhaust from the turbine, the diffuser including at least two nested frustoconical members that define at least two separate flow paths for the flow of exhaust through the diffuser, the diffuser having an inlet end defining an inlet flow area, and an outlet end defining an outlet flow area that is larger than the inlet flow area, the diffuser reducing the flow rate of the flow of exhaust as the flow of exhaust flows from the inlet end to the outlet end; and
 - a plenum delivering the flow of exhaust from the diffuser to the hot gas flow path of the recuperator such that the exhaust gas heats the compressed gas within the recuperator.

2. The engine of claim 1, wherein the plenum receives the flow of exhaust from the diffuser in a first direction and delivers the flow of exhaust to the recuperator in a second direction that is substantially opposite the first direction.
3. The engine of claim 1, wherein the ratio of outlet flow area to the inlet flow area of the diffuser is between about 3 to 1 and about 7 to 1.
4. The engine of claim 1, wherein the ratio of outlet flow area to the inlet flow area of the diffuser is between about 4 to 1 and about 5 to 1.
5. The engine of claim 1, wherein the diffusion angle of each of the at least two separate flow paths in the diffuser is not greater than about 7°.
6. The engine of claim 1, wherein the diffusion angle of the innermost flow path of the at least two separate flow paths of the diffuser is not greater than about 7°, and wherein the diffusion angle of each of the rest of the flow paths in the diffuser is not greater than about 5°.

7. The engine of claim 1, wherein the at least two nested frustoconical members include first, second, third, and fourth frustoconical members; wherein the first frustoconical member defines a first one of the at least two flow paths; wherein the second frustoconical member surrounds the first frustoconical member such that a second one of the at least two flow paths is defined between the first and second frustoconical members; wherein the third frustoconical member surrounds the second frustoconical member such that a third one of the at least two flow paths is defined between the second and third frustoconical members; and wherein the fourth frustoconical member surrounds the third frustoconical member such that a fourth one of the at least two flow paths is defined between the third and fourth frustoconical members.

8. The engine of claim 7, wherein the first, second, third, and fourth frustoconical members are arranged substantially coaxially with each other.

9. The engine of claim 7, wherein the first flow path has a diffusion angle about 7°, wherein the second and third flow paths each have a diffusion angle of about 3.5°, and wherein the fourth flow path has a diffusion angle of about 0.5°.

10. The engine of claim 1, wherein each of the at least two frustoconical members includes an inner surface and an outer surface, the engine further comprising at least one strut interconnected between the inner surface of one of the frustoconical members and the outer surface of another of the frustoconical members.

11. The engine of claim 10, wherein the strut is substantially tangent to the outer surface to which it is interconnected.

12. The engine of claim 10, wherein the strut permits respective rotation between the frustoconical members while maintaining a substantially constant spacing therebetween.

13. The engine of claim 10, wherein the strut is interconnected with the outer surface by way of a slot in the outer surface, such that the strut is movable within the slot to permit relative movement between the frustoconical members.

14. The engine of claim 1, wherein the at least two frustoconical members includes a plurality of pairs of frustoconical members, each pair consisting of an inner and an outer frustoconical member, the engine further comprising three struts interconnecting an inner surface of each outer frustoconical member to the outer surface of the inner frustoconical member with which it is paired.

15. The engine of claim 14, wherein each strut is substantially tangent to the outer surface to which it is interconnected.

16. The engine of claim 1, wherein the turbine exhausts the exhaust gas at a flow rate of about 800 ft./sec. and wherein the diffuser reduces the flow rate of exhaust gas to about 50 to 100 ft./sec.

17. A diffuser comprising:

at least two nested frustoconical members, each including an inner surface and an outer surface; and

at least one strut interconnected between the inner surface of one of the frustoconical members and the outer surface of another of the frustoconical members;

wherein the strut is substantially tangent to the outer surface to which it is interconnected.

18. The engine of claim 17, wherein the strut permits respective rotation between the frustoconical members while maintaining a substantially constant spacing therebetween.

19. The engine of claim 17, wherein the strut is interconnected with the outer surface by way of a slot in the outer surface, such that the strut is movable within the slot to permit relative movement between the frustoconical members.

20. The engine of claim 17, wherein the at least two frustoconical members includes a plurality of pairs of frustoconical members, each pair consisting of an inner and an outer frustoconical member, and wherein the at least one strut includes three struts interconnecting an inner surface of each outer frustoconical member to the outer surface of the inner frustoconical member with which it is paired.

21. The engine of claim 20, wherein each strut is substantially tangent to the outer surface to which it is interconnected.

22. A combustion turbine engine comprising:

- a recuperator having a hot gas flow path and a cool gas flow path;
- a compressor providing a flow of compressed gas to the cool gas flow path of the recuperator, the compressed gas being heated within the recuperator;
- a source of fuel providing a flow of fuel;
- a combustor receiving the heated flow of compressed gas from the recuperator and the flow of fuel from the source of fuel, and combusting a mixture of compressed gas and fuel to produce a flow of hot gas;
- a radial flow turbine receiving the flow of hot gas from the combustor and discharging a flow of exhaust gas, the turbine including a rotating element that rotates in response to the flow of hot gas through the turbine;
- an electric generator generating electricity in response to rotation of the rotating element of the turbine;
- a diffuser receiving the flow of exhaust from the turbine, the diffuser having a longitudinal axis and including inner and outer nested frustoconical members, the inner frustoconical member defining an inner flow path that includes a portion of the longitudinal axis of the diffuser, the inner and outer frustoconical members defining therebetween an outer flow path; and
- a plenum delivering the flow of exhaust from the diffuser to the hot gas flow path of the recuperator such that the exhaust gas heats the compressed gas within the recuperator.

23. The engine of claim 22, wherein the outer flow path is annular in shape and is centered around the longitudinal axis.

24. The engine of claim 22, further comprising struts in the diffuser interconnecting the inner conical member and the outer conical member, the struts extending substantially radially away with respect to the longitudinal axis.

25. The engine of claim 24, wherein the struts include a pair of struts in each of the front and rear halves of the diffuser.

26. The engine of claim 25, wherein each pair of struts is disposed about 45° on either side of a vertical plane that includes the longitudinal axis.

27. The engine of claim 24, wherein the struts are tubular and have a wall that is of substantially the same thickness as the walls of the inner and outer conical members.

28. The engine of claim 27, wherein the struts are welded to each of the inner and outer conical members.

29. The engine of claim 28, wherein the struts pierce through each of the inner and outer conical members.

30. The engine of claim 29, further comprising a cap closing off an inner end of each strut and welded to the inner surface of the inner conical member.